Technology Opportunity

Multiresolution Analysis

Multiresolution analysis methods are being developed at the National Aeronautics and Space Administration (NASA) Lewis Research Center to solve various specific problems in dynamics, controls, and fluid mechanics. Multiresolution analysis is very effective for unraveling or synthesizing complex data features such as edges, textures, and noises. Features of any particular scale and region in the data can be separated from the background for display and extraction. We found that this special capability of multiresolution techniques is particularly useful in the following fields: structural vibrations, fluid mechanics, turbojet compressor stall/surge detection and control, and dynamic and control systems.

Potential Commercial Uses

- The development of practical multiresolution analysis techniques may greatly benefit or revolutionize the following fields: spectrography, acoustics, voice recognition, self-diagnostic control systems, diagnostic image and signal processing, fluid mechanics research and modeling, smart engine controls, and others.
- Several significant advances have been made with multiresolution analysis for launch vehicle structural vibration analysis, high-speed compressor stall/surge detection, and control for turbojet engines.
- NASA Lewis is collaborating with General Electric Aircraft Engines (GEAE) in Cincinnati, Ohio, and Syracuse University to develop multiresolution analysis methods for GEAE's low-speed research facilities.

Benefits

Lewis-developed multiresolution methods and algorithms facilitate maximum use of the flexibility, thoroughness, and sharpness of multiresolution analysis in many dynamics, control, and diagnostic data-processing problems of aerospace engineering.

The Technology

Instead of using pure sinusoidal curves as in Fourier analysis, multiresolution data analysis can be performed with short wave-forms of varying amplitude, called wavelets. All features in data (e.g., a recorded voice) can be matched by contracting and/or stretching a suitably chosen wavelet. Features also can be matched, as in image processing, by processing the data to give it a gray-scale morphology, so that only features of chosen length scales and shapes are retained and enhanced, while the rest are gradually suppressed. The multiresolution analysis development effort at Lewis is aimed at establishing a user-friendly link from these fundamental ideas and formulations to common practices in the fields of dynamics, control, and data analysis or processing. Many classical analysis methods (e.g., correlation analysis, power spectrum, and linear systems theory) have been generalized or reformulated for these new ways of viewing and representing data.

Options for Commercialization

Our multiresolution analysis methodology, algorithm, and special applications have been or will be published. Partnership with industry to transfer our software or future real-time processors for multiresolution analysis to industrial and medical practices are also feasible.

National Aeronautics and Space Administration
Lewis Research Center

Contact

Dr. Dzu K. Le
Electronics and Control Systems Division
NASA Lewis Research Center
Mail Stop 86-5
21000 Brookpark Road
Cleveland, OH 44135
Phone: (216) 433-5640
Fax: (216) 433-6382
E-mail: scdle@ariel.lerc.nasa.gov

Key Words

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